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ABSTRACT

American economic analysts will better understand current economic trends if they investigate economic problems in light of the expanding global economy. Reasons for the failure of economists to explain the simultaneous existence of rapid inflation and high unemployment include preoccupation with economic indicators, short-term forecasts, and econometric models. Instead of concentrating on symptoms of economic maladies, economists should consider their underlying causes such as the role of biological systems in the economy. The four major biological systems--fisheries, forests, grasslands, and croplands--form the foundation of the global economic system. Economists' general lack of ecological awareness has caused them to ignore the economic impact of practices such as overgrazing, deforestation, rapid population growth, conversion of grasslands into croplands, encroachment of cities and deserts on croplands, depletion of nonrenewable energy sources, unemployment, capital scarcity, diminishing returns, and rising real costs accompanied by inflationary pressures. Many current economic problems are rooted in the deteriorating relationship between the world's four billion inhabitants and the earth's natural systems and resources. Economists should realize that many economic problems stem from the dependence of the economic system upon the natural environment. (Author/DB)

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The Global Economic Prospect: New Sources of Economic Stress

Lester R. Brown

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Introduction

In economic terms, the seventies have been traumatic and confusing. They brought the first global double-digit inflation on record during peacetime and the highest unemployment since the Great Depression. The dramatic rise in the world price of oil, wheat, and soybeans during the mid-seventies caught economic analysts and political leaders off guard.

Economic advisors are puzzled by the simultaneous existence of rapid rates of inflation and high unemployment. The economics fraternity has had trouble explaining, much less anticipating, the trends of the seventies. This shortcoming was acknowledged by Walter Heller in his 1974 Presidential address to the American Economic Association when he said, "We [economists] have been caught with our parameters down."[1]

While most economists recognize that something is wrong, few have had much success in determining exactly what. Increasingly preoccupied with economic indicators, short-term forecasts, and econometric models, economists appear not to have noticed that the expanding global economy, fueled by both rising affluence and population growth, has begun to outstrip the carrying capacity of some of the earth's biological systems and to deplete some of its key resources. Many of our current "economic" problems are rooted in this deteriorating relationship between the world's population, now numbering four billion, and the earth's natural systems and resources.

This paper is based largely on the author's more detailed analysis, *The Twenty-Ninth Day: Accommodating Human Needs and Numbers to the Earth's Resources* (W. W. Norton & Co., April 1978).

I am indebted to my colleague Christopher Flavin for his assistance with the research and analysis underlying this paper, and to Lincoln Gordon, George Iden, and Marshall Robinson for their reviews of the manuscript.

6 The Biological Foundations of the Economy

Economists are unaccustomed to thinking about the role of biological systems in the economy, much less the condition of these systems. The economist's desk may be covered with references containing the latest indicators of the health of the economy but rare indeed is the economist concerned with the health of the earth's principal biological systems. This lack of ecological awareness has contributed to some of the shortcomings in economic analysis and policy formulation during the seventies.

Four biological systems—fisheries, forests, grasslands, and croplands—form the foundation of the global economic system. In addition to supplying all our food, these four systems provide virtually all the raw materials for industry except minerals and petroleum-derived synthetics. The condition of the economy and of these biological systems cannot be separated.

As the global economy expands at 4 percent per year, or 50-fold per century, pressures on the earth's biological systems are mounting. In large areas of the world, human claims on these systems are reaching an unsustainable level, a point where their productivity is being impaired. When this happens, fisheries collapse, forests disappear, grasslands are converted into barren wastelands, and croplands deteriorate.

Oceanic fisheries are one of humanity's principal sources of high-quality protein. Throughout most of human history there were far more fish in the oceans than we could ever hope to catch. Between 1950 and 1970, fish supplied an increasing part of the human diet as the technological capacity to exploit oceanic fisheries expanded. During this two-decade span, the catch more than tripled, climbing from 21 to 70 million tons.[2] By 1970, the catch averaged some 10 kilograms (22 pounds) per person annually, well above the yield from the world's beef herds.

But in 1970 the trend was abruptly and unexpectedly interrupted. (See Figure 1.) The productivity of scores of oceanic fisheries is falling as the catch exceeds the regenerative capacity. Since 1970, the catch has fluctuated between 65 and 70 million tons, clouding the prospects for an ever-bigger catch. Meanwhile, world population growth has led to an 11-percent decline in the per capita catch and to rising seafood prices everywhere. In a protein-hungry world, overfishing is now the rule, not the exception.

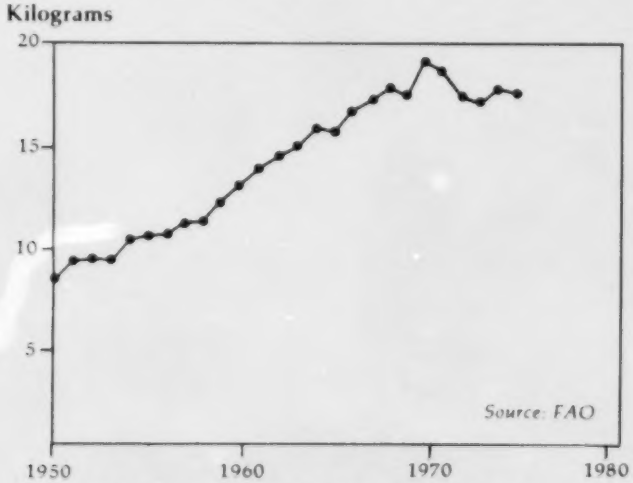

Figure 1: World Fish Catch Per Capita, 1950-75

Forests provide not only lumber, but, for fully a third of humanity, firewood as well. In the poor countries where firewood is used for cooking, villagers are decimating local forests. With the average villager requiring a ton or more of firewood each year, expanding village

8 populations are raising firewood demands so fast that the regenerative capacities of many forests are being surpassed.[3] Under the pressure of population growth, forests are receding farther and farther from the villages until entire regions and countries are eventually deforested.

While firewood is a principal energy source only in developing countries, wood is the primary building material in all countries. Some of the world's finest timber stands are shrinking as lumber needs mount. Each year, some 64 million new inhabitants need to be housed. This continued pressure, combined with the need to replace old houses, is raising total claims on many remaining forests far beyond the level that can be sustained without improved management and a massive increase in tree planting.

A third major pressure on the earth's woodlands comes from the demand for paper. In modern industrial societies, where more people are employed in offices than in factories and on farms, paper is a major raw material. It is the common medium of both mass and interpersonal communication everywhere. As the share of humanity that is literate expands, the demand for newsprint increases even faster than population. The lack of paper-recycling facilities in the major consuming countries adds to these rising demands.

Most of the Middle East and North Africa and much of continental Asia, Central America, and the Andean regions of South America are now virtually treeless. Wood and wood products have become scarce and expensive in denuded areas. Only in China and South Korea have reforestation efforts been sufficient to reverse these trends. Elsewhere in the Third World, forests are shrinking before the onslaught of the firewood gatherer, the home builder, and the land-hungry farmer.

On every continent the area in grass exceeds that planted to crops. Besides supplying protein for human consumption, grasslands are a source of energy for agriculture: roughage provides the food for the

"In some countries, such as the United States, the cropland being lost exceeds the new land being brought under the plow."

draft animals that cultivate one-third or more of the world's cropland. An integral part of both the food and energy sectors of the world economy, these grasslands and the 2.7 billion domesticated ruminants they support are also an essential source of raw materials for industry, supplying leather for the footwear and leather goods industries and wool for the textile industry. Their production potential and their condition directly influence the prospect not only of feeding our still-growing population but also of expanding the global economy further. 9

Together, population growth and rising affluence are increasing demands on the world's grasslands at a time when overgrazing is already commonplace. As these demand pressures build, many countries will find it difficult to continuously expand livestock numbers. Even with further gains in production per animal it will be difficult to maintain the per capita supply of livestock products. Because the best grasslands have been converted into croplands, most of those remaining either are concentrated in arid or semi-arid regions or are located on land that is too steeply sloping to be farmed. Semi-arid and steeply sloping grasslands are among the most fragile ecosystems, capable of surviving only if grazing is carefully controlled.

In addition to the frequently unsustainable pressures on the three natural systems described above, pressures are mounting on the crop-producing systems as well. The human prospect is closely linked to the size and condition of this cropland base, the foundation not only of agriculture but of civilization itself. Even while the amount of new land awaiting the plow shrinks, the growth in demand for food expands at a record pace.

Cities and deserts are encroaching on cropland on virtually every continent. In some countries, such as the United States, the cropland being lost exceeds the new land being brought under the plow. In *Science*, David Pimentel reports that "each year more than one million hectares of arable cropland are lost to highways, urbanization, and other special uses." This loss is only "partially offset by the addi-

10 tion (primarily through irrigation and drainage projects) of 500,000 hectares of newly developed cropland per year."[4]

In addition to the absolute loss of cropland through abandonment or conversion to other uses, erosion is leading to a thinning of the topsoil layer and thus to a decline in the natural fertility of soils. Soil erosion is not new, but in vast areas the topsoil now being lost through erosion exceeds that being formed by nature. In the short run, this decline in innate fertility can be masked by the increased use of fertilizer.

In an earlier era, the prospect of vanishing forests or fisheries would not have been an issue of such great concern because it was believed that tree farming and fish farming could supplement the natural systems. But converting natural systems to managed ones requires energy—energy that has become costly and promises to remain so far into the future. The steep increase in oil prices does not necessarily rule out the expansion of tree or fish farming, but it does make it more costly and therefore more difficult.

The extensive deterioration of the earth's principal biological systems is not an issue of concern only to environmentalists. Our economic system depends on these systems. Anything that seriously threatens their productivity threatens the productivity of the global economy.

Fueling the Economic System

Over the past generation, cheap energy has shaped the global economic system and helped triple the output of goods and services. It may also have raised expectations of material consumption to unrealistic levels. The fivefold increase in the price of oil during this decade heralds the end of cheap energy. Coming at a time when some people live in affluence while others cannot satisfy even basic physical needs, the transition from cheap to expensive energy raises difficul. political issues both within and among societies.

Today humanity annually uses the energy equivalent of nearly nine billion tons of coal, or just over two tons per person, not including firewood and cow dung. Within individual countries, per capita consumption varies from a few hundred kilograms in Angola, Ethiopia, or India to 12 tons in the United States.[5] These widely varying levels of energy use help explain sharply contrasting life-styles among societies. In poorer societies, such as Ethiopia, few people have access to electricity or own automobiles, and there is almost no heavy industry. In parts of East Africa, the Indian subcontinent, and the Andes, even traditional energy sources such as forage for draft animals and firewood for cooking are now scarce.

During the twentieth century, world petroleum production expanded steadily until eventually oil replaced coal as humanity's principal source of energy. From the turn of the century onward, U.S. petroleum production continued to grow, making it the world's largest producer of oil. But the dramatic expansion in oil production during the forties and fifties tapered off in the late sixties and came to a halt in 1970.

After peaking at 3.6 billion barrels per year in 1970, U.S. oil production then began to decline, reversing a century-long trend. By 1977, it had fallen to 2.8 billion barrels per year. (See Figure 2.) The gap between continuously rising demand and falling production has been filled by imported oil. Although the United States can afford to import massive quantities of oil, the economic repercussions of the late-1973 price rise for less wealthy oil-importing countries have been severe, leading in some cases to heavy external indebtedness and internal deprivation.

The decline in production already under way in the United States will be followed by downturns in other oil-producing countries. The Soviet Union may lose its exportable surplus of oil within a matter of years, leaving Eastern Europe heavily dependent on the Middle East and other sources for all imports. As output begins to fall in some of the older oil fields, the pressures on newer fields will mount.

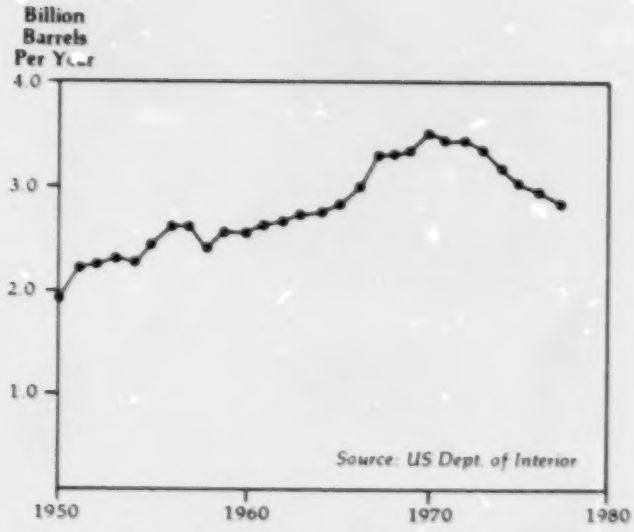

Figure 2: U.S. Crude Oil Production, 1950-77

As this process continues, a snowball effect will take hold and a market psychology of scarcity will come into force. If energy alternatives are not available soon at comparably cheap prices, the nineties may witness not only the end of the petroleum era, but also the end of the profligate economic system oil has spawned.

The sobering reality of oil depletion is only beginning to permeate public consciousness. Until recently, technology held out two promising alternatives: the extraction of oil from the vast reserves of shale and tar sands, and the development of cheap nuclear power. Many believed that the oil that is tightly locked in oil shale or heavy tar

sands could be readily extracted. But discouraging setbacks have marred the seventies. Efforts to develop the vast shale deposits in Colorado and Wyoming have been abandoned by many private companies because of the cost. Similarly, some of the firms that hoped to "mine" the Althabascan tar sands, once touted as containing more petroleum than the oil fields of Saudi Arabia, are shelving the notion. Without the heavy commitment of Canadian Government funds, efforts to develop the tar sands might well have collapsed. *Business Week* has described shale oil as "a researcher's dream and an economist's nightmare."[6]

Events of the seventies have also altered the outlook for nuclear power. An international survey in early 1977 reported that the timetables for nuclear power "are in shambles."[7] The U.S. Government has dramatically lowered its projections of nuclear power capacity for the year 2000. In 1974, official projections indicated that nuclear-generated electrical capacity by the end of the century would reach 1,250,000 megawatts. In July 1976, these estimates were revised downward to 450,000-800,000 megawatts. Two months later the figures were further reduced to 380,000-620,000 megawatts.[8] Similar reductions in the projections are occurring at the global level. In 1970, the International Atomic Energy Agency projected that some 610,000 megawatts would be on line by 1985 in the non-Communist countries. A recent forecast by the Atomic Industrial Forum, an industry trade group, projects only 375,000 megawatts by 1985 for the entire world.[9] Continuing setbacks in the industry suggest that even these projections are on the high side.

At least six obstacles or problems beset nuclear power: the risk of a reactor meltdown or other accident; the danger of nuclear materials falling into the hands of terrorists; the lack of a satisfactory technique for disposing of nuclear waste; the possibility that nuclear weapons will spread; the long-term inadequacy of fissile fuel supplies; and, perhaps most importantly, cost, including the cost of waste disposal and of decommissioning worn-out plants. The difficulty in dealing effectively with any one of these obstacles, much less

with all of them collectively, raises serious questions about whether nuclear power will ever fulfill the mission its proponents set for it.

As recently as April 1977, President Carter, in outlining to Congress his long-term energy plan, stated that coal would be a cornerstone of the U.S. energy program. But a few months later the National Academy of Sciences released a study on energy and climate that pointed out that continued heavy burning of coal would almost certainly raise carbon dioxide levels, leading to a warming of the earth. They projected a warming of 6°C (11°F) within two centuries.[10] Even a 5°C warming of the oceans would raise the sea level through simple expansion alone by three feet. If, as a more recent article in *Nature* projects, this warming led to a partial breakup of the Antarctic ice cap, the ocean levels would rise much farther, inundating low-lying coastal areas and cities throughout the world.[11]

The implications of these discouraging scenarios for oil, nuclear power, and coal were recognized in early March 1978 when John O'Leary, Deputy Secretary for Energy, noted that these conventional sources of energy could at best only sustain the status quo. He went further than most U.S. officials have concerning the prospects for nuclear power when he declared that "nuclear power is a has-been."[12]

The world is not running out of energy, but it *is* running out of oil, and appears to be running out of cheap energy. As the price of energy rises, new sources will come into use. A world economic system where a barrel of oil costs $20 will look far different than one that evolved when the price of oil was less than $2 per barrel. Energy will be used sparingly and waste will be minimal. Far-reaching adjustments are called for not only in developing new energy sources but also in mobilizing scientific and engineering know-how to increase energy efficiency in every sector of the global economy.

All signs point to the need for a crash program to develop renewable energy sources—solar energy, in effect, in its various direct and indirect forms. These include solar collectors for space and water heat-

"A world economic system where a barrel of oil costs $20 will look far different than one that evolved when the price of oil was less than $2 per barrel."

ing, wind power, photovoltaic cells for converting sunlight into electricity, water power, methane generators, firewood, energy crops, and schemes to convert urban garbage into usable heat and electricity. Each country must evolve its own strategy for moving into the post-petroleum era according to local circumstances. The transition promises to be difficult. The more time there is to make this transition, to develop technologies, and to make investments on a scale sufficient to maintain essential economic activities, the better. 15

Diminishing Returns

The principle that investing ever-increasing amounts of capital or labor in any activity will eventually result in diminishing returns was discussed in detail in the nineteenth-century writings of David Ricardo. Ricardo's early work dealt primarily with the application of labor to land and did not anticipate the many technological advances that pushed the point of diminishing returns farther and farther back. His thinking, like that of Malthus, thus came under attack because his projections did not materialize in the short run. Indeed, as science and technology progressed, many came to believe that the point of diminishing returns, the day of economic reckoning, could be postponed indefinitely.

While Ricardo's preoccupation with diminishing returns may have been premature, it was nonetheless well-founded. With the global economy growing in recent decades at a rate of 50-fold per century, it should come as no surprise that eventually it will be forced to rely upon resources of declining quality. Technological advances may more than offset declines in resource quality for awhile, but at some point the most ingenious attempts to compensate for nature's limitations will no longer be adequate.

In recent years, the decline in the quality of additional resources has been evident in agriculture. The gradual long-term rise in world grain yield per acre, one of the most predictable of postwar economic trends, has been interrupted during the seventies. In part this is because the

additional land brought into production has been of below average quality. This is particularly true in the United States, where some 50 million acres of cropland previously idled under farm programs were released for production in 1973 and 1974. As of 1977, U.S. per-acre yields of all cereals were below those of the early seventies.[13] Worldwide, the lower quality of additional land brought into use during the mid-seventies, combined with the high prices of fertilizer and fuel and with adverse weather in some regions, acted to override the broad-based efforts by the world's farmers to raise land productivity.

Since mid-century, the supply of fertile new land has shrunk, leading farmers to intensify cultivation on existing cropland by using irrigation and chemical fertilizers. But just as the extension of agriculture onto new land eventually runs up against diminishing returns, the development of water resources and the expansion of fertilizer use also have limitations. Most of the world's easy-to-irrigate sites have already been developed. Further expansion in irrigation invariably involves heavy expenditures.

While the application of chemical fertilizer has accounted for much of the increase in world food output since mid-century, returns on additional fertilizer use are beginning to fall off in those areas where its use has been heaviest. Crop yields increase predictably with each increment of chemical fertilizer—rapidly at first, then more slowly until they eventually level off. The shape of this fertilizer-response curve is central to any analysis of future food-production prospects, because the doubling of world grain output since 1950 is due more to the expanded use of commercial fertilizer than to any other factor.

The earliest data for both world grain production and fertilizer use are those for 1934-38. (See Table 1.) At that time world grain production averaged 651 million tons per year and fertilizer consumption totaled a rather modest ten million tons. From then until 1948-52, fertilizer consumption increased by only four million tons. As growth in the cultivated area slowed after 1950, fertilizer consumption began to grow by leaps and bounds. During the fifties, each additional mil-

lion tons in annual fertilizer use was associated with a ten-million-ton increase in the grain harvest. During the early sixties, the response per extra million tons of fertilizer used declined to 8.2 million tons; during the late sixties, it fell further to 7.2 million tons. By the early seventies, each additional million tons of fertilizer yielded only an extra 5.8 million tons of grain.

Table 1: World Grain Production and Fertilizer Use

Year	World Grain Production	Grain Increment	World Fertilizer Use	Fertilizer Increment	Grain Increment Per Ton of Fertilizer
		(million metric tons)			
1934-38	651		10		
1948-52	710	59	14	4	14.8
1959-61	840	130	27	13	10.0
1964-66	955	115	41	14	8.2
1969-71	1,120	165	64	23	7.2
1974-76	1,236	116	84	20	5.8

Source: Food and Agriculture Organization and U.S. Department of Agriculture.

These global averages conceal wide variations among individual countries. While opportunities for the profitable use of additional fertilizer appear limited in Japan and Western Europe, they are still quite high in India and Argentina where current usage rates remain low. But even allowing for possible shifts in the world pattern of fertilizer use between cereals and other crops, it seems clear that returns on the use of ever-expanding amounts of this key agricultural input are diminishing. Barring either a marked improvement in the capacity of cereals to utilize fertilizer or a sharp rise in food prices relative to those of fertilizer, growth in the use of this key input will begin to slow. In fact, it has already tapered off. Ranging from 7 to 9 percent between 1950 and 1970, the annual growth in world fertilizer use has fallen below 6 percent during the seventies.

18 Efforts to expand the world fish catch represent another clearly documented case of diminishing returns. Even though overfishing has become commonplace, countries and corporations continue to invest in new fishing equipment. In its review of fisheries for 1975, the Organization for Economic Cooperation and Development (OECD) reports that "the total gross tonnage of the world's fishing vessels over 100 GRT (gross registered tonnage) has grown by more than 50 percent in the six years to mid-1975."[14] During the same period the world catch did not increase at all, which means that the catch per dollar invested fell precipitously.

With energy as with food, efforts to expand supplies meet with diminishing returns. The most promising prospects for discovering new underground oil fields have been thoroughly investigated. Geological and seismic data indicate that new finds will be relatively meager compared to past discoveries. New finds are invariably located in more remote and inhospitable spots. Off-shore drilling, which accounts for a substantial and growing share of the total oil-exploration effort, can cost several times more per barrel than drilling on land.

Diminishing returns also govern the mining industry. During the first seven decades of this century, the cost of unearthing minerals generally declined as mining and extraction technologies advanced and as energy became cheap and abundant. But as mineral reserves dwindle, lower-grade ores and less accessible deposits must be mined.

Even the mining of relatively abundant minerals, such as iron ore, eventually faces the prospect of diminishing returns. According to a World Bank analysis on the future of the iron-mining industry, "new discoveries during the last 25 years of world reserves of all grades of ore are now deemed sufficient to last at least 100 years at exponentially growing demand." But the report then adds that "increasing claims have been made on the world's reserves of high-grade ore since World War II," and "while present reserves of all grades of ore are ample, the greatest iron resources of the world are in low-grade deposits."[15]

"Even though overfishing has become commonplace, countries and corporations continue to invest in new fishing equipment."

Diminishing returns in mining initially occurred in those Western European countries that industrialized first, since their richer domestic deposits were exhausted relatively early. While these countries could turn to foreign supplies, the world as a whole obviously cannot take the same approach. Overall, technological advances in mineral extraction and refining are not likely to always offset the added costs that mining lower-grade and less accessible ore deposits entails. In addition, turning to lower-grade ores or to less accessible deposits raises the requirements for energy, a resource with its own rising cost curve.

All economies are being affected by diminishing returns regardless of their economic systems. In an analysis of the Soviet economic slowdown during the seventies, Harvard economist Abram Bergson noted that "the USSR is notably well endowed with industrial resources of almost every description, but it must resort increasingly to inferior and less accessible deposits. As a result, as Soviet planners are discovering to their chagrin, the law of diminishing returns also operates under socialist planning."[18]

Another source of diminishing returns on investments, the limited capacity of the earth's ecosystem to absorb waste, cuts across virtually every sector of economic activity. At some point, the cost of environmental damage caused by a given economic activity can exceed the value of the product itself, though neither the producer nor the consumer may realize this since the larger community bears the cost. As concerned governments impose restrictions on the discharge of wastes, in order to protect human health and to preserve the biological systems on which human survival depends, industry will return less product per dollar invested.

Investment in research, where advances were once expected to offset the diminishing returns associated with continuous expansion of global economic activity, may itself be experiencing diminishing returns. Within agriculture, for example, the development of chemical fertilizer and cereal hybridization required relatively small investments of time and money, but comparable future advances in food produc-

tion may be far harder to realize. In physics, splitting the atom and developing solid-state physics were landmark breakthroughs, but comparable seminal gains in the future may require the lifetime efforts of thousands of highly trained physicists.

It is not yet certain whether returns on investment in research and development (R&D) are diminishing. It is certain, however, that U.S. investment in R&D as a share of gross national product (GNP) is now declining. After moving steadily upward following World War II, R&D investments as a share of GNP peaked at 2.91 percent in 1966, and then began a steady decline. By 1975, the last year for which data are available, the figure had fallen to 2.33 percent.[17] Given the important contribution of new knowledge to economic growth and factor productivity, the long-term economic implications of a continuation of this trend are obvious.

New Sources of Inflation

Closely related to the diminishing returns that plague efforts to expand output in many key sectors of the global economy is the problem of rising real costs and the associated inflationary pressures. Global double-digit inflation is unique to the seventies, but the pressures leading up to it have been building for decades. From the middle of this century onward, the average rate of price increase has been gradually accelerating in the OECD countries, the countries that account for the lion's share of world economic output. From 1958 to 1967, the annual rate of inflation was 2.5 percent. From 1968 to 1972, it increased to 4.8 percent. By 1974, it had moved into the double-digit range, exceeding 10 percent. In 1976, following two consecutive years of recession in the OECD countries, the annual inflation rate was still running at 7 percent.[18] As of early 1978, inflationary pressures may be intensifying further.

Historically, inflation usually has been a localized phenomenon, affecting individual countries from time to time, but during the seven-

ties it has assumed a global dimension. The coincidental meshing of the economic cycles of the major industrial countries in the mid-seventies contributed to both inflation's spread and its virulence. With virtually all the industrial economies simultaneously on the upswing, the worldwide demand for raw materials and manufactured goods expanded at a record rate.

Global inflation has created extreme anxiety among national political leaders who must try to cope with it. The economists whose advice national leaders seek are puzzled by the failure of all traditional inflation controls short of the sanction of widespread unemployment. Indeed, inflation may be the great unsolved problem of modern economics. British economist Joan Robinson doubts that a solution can be found within the context of conventional economics. Robinson describes the problem with precision, but summarizes with a disclaimer: "Economics can't answer it."[19]

The causes of inflation traditionally enumerated in economics textbooks include wage increases that exceed productivity gains, excessive demand stemming from "easy" money or deficit financing, short-term supply shortages following crop failures or other supply disruptions, and "administered" prices that have an upward bias. By the latter, economists mean prices that are fixed either as a result of a concentration of economic power within an industry or by some governmental marketing board or other body.

Although not easily managed, these traditional sources of inflation are at least understood reasonably well, as are the techniques for coping with them. It may not be easy for political leaders to persuade labor-union leaders to exercise restraint in contract negotiations or to convince powerful industries to keep the inflationary effects of price increases in mind as they price their products. But at least leaders can try; the remedy is known. Whenever inflation arising from deficit financing gets out of hand, reducing the deficit and slowing the rate of economic growth will usually curb it.

22 In this discussion, inflation is defined as including rises not only in monetary prices but also in the effort required to satisfy a given need. For example, if the effort required by an Andean village family to gather firewood increases as deforestation progresses, this is treated as inflation even though the commodity does not move through the marketplace. Similarly, if a Nigerian farmer is forced to expend more effort to produce food for his family because his soil is eroding, this must be considered inflation. Although there is no price "inflated" in these two examples, the effect is the same—a reduction in living level if the effort expended remains the same.

During the seventies, efforts to manage inflation have been consistently less successful than in the past, in part because new sources of inflation are emerging. In simplest terms, the new inflationary forces arise from the claims on the earth's resources of a continuously expanding global economy. As described earlier, at some point biological systems begin to deteriorate; oil wells begin to go dry; high-grade, easily accessible mineral reserves are used up; and there is no more fertile, well-watered cropland that can easily be brought under the plow. As the demand for the more scarce resources begins to outstrip supplies, scarcity-induced price rises result.

Historically, if commodity A became scarce, commodity B was substituted for it. But substituting the plentiful for the scarce is no longer always an option. Attempts to substitute may only ensure that scarcity is contagious. As Willis Harman of the Stanford Research Institute explains, "Because all of these interdependent factors are approaching planetary limits together, the solutions that resolved scarcity problems in the past—geographic expansion and technological advancement—do not promise the same sort of relief in the future."[20]

This situation described by Harman contrasts sharply with that during the first seven decades of this century, when the real costs of most industrial raw materials, foodstuffs, and fuels declined.[21] In fact, during the two-decade span from 1950 to 1970, the money price

"The new inflationary forces arise from the claims on the earth's resources of a continuously expanding global economy."

of such basic commodities as oil, wheat, and lumber remained essentially unchanged. Thus when the costs are adjusted for overall price inflation, their real prices declined substantially throughout this period.

Since the early seventies, the prices of many basic raw materials have climbed as a result of either scarcity or rising real costs (costs, that is, that rise faster than the overall rate of inflation). Where the latter are concerned, the key issue is whether advancing technology can offset the declining quality of natural resources. If advancing technology can quickly provide an abundance of cheap alternatives to oil, then the depletion of reserves is not a matter of concern. If advancing technology can offset the decline in ore quality or in the quality of new cropland, then continuing growth will not bring rising real costs.

Prices of many commodities, both nonrenewable and renewable, have departed dramatically from historical trends during the seventies. The fivefold increase in the price of oil thus far during this decade is perhaps the most dramatic. (See Figure 3.) These steep rises in petroleum prices reflected the decision by members of the Organization of Petroleum Exporting Countries (OPEC) to "administer" prices, but the strength to make their resolution stick derived from the ability of principal suppliers such as Saudi Arabia and Kuwait to restrict production and from the lack of suitable substitutes for oil.

Although OPEC raised the price of oil, the organization only did what market forces would do more gradually as oil reserves dwindle. New sources of oil are proving to be unexpectedly costly. The production of North Sea oil has been fraught with unanticipated costs. The expense of transporting oil from remote regions such as Central Siberia or the North Slope of Alaska also boosted costs. According to a U.S. Government study released in early 1977, the $5- to $8-per-barrel cost of transporting oil from Alaska's North Slope to the U.S. Pacific Coast is so high that if this oil were priced at the same level as other new oil in the continental United States, its delivered price would ex-

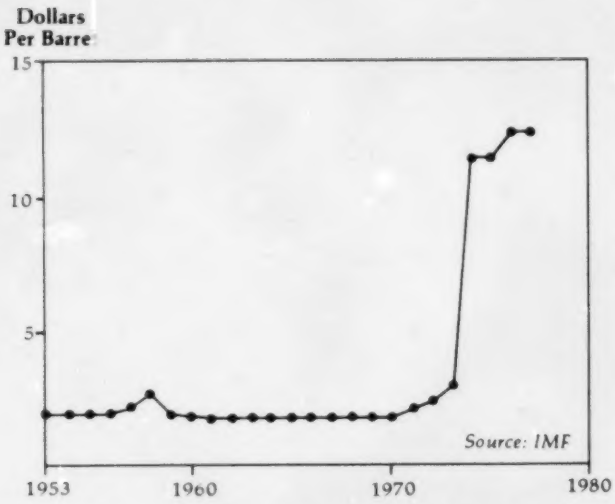

Figure 3: World Price of Petroleum, 1953-77

ceed that of OPEC oil.[22] In fact, alternative energy sources under development do not appear capable of seriously undercutting the OPEC oil price.

The commodity prices of renewable resources have also increased dramatically during the seventies, although the fluctuations have been more in response to changing market conditions. The world price of wheat, for example, tripled between 1970 and 1974. The leap in price followed the massive Soviet purchase of U.S. wheat during the summer of 1972. Yet the Soviet deal should be seen as a triggering event bringing the longer-term trends into focus. The rapid growth in the global demand for food during the decade, reflecting

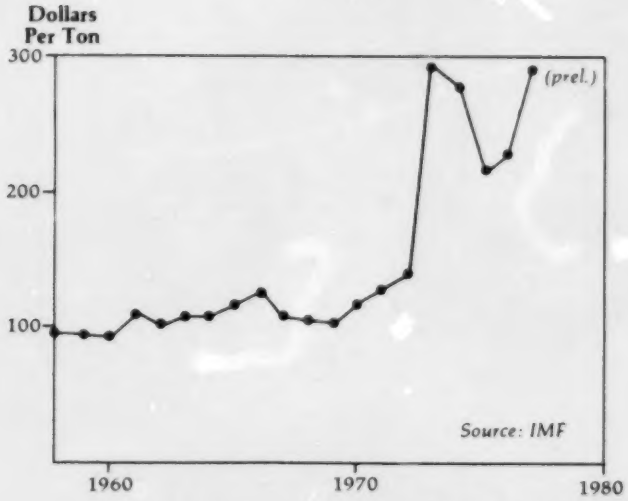

Figure 4: World Price of Soybeans, 1958-77

both population growth and an uncommonly rapid rise in affluence during that period, simply outstripped the capacity of farmers to continue supplying wheat and other commodities at the earlier price levels. Although unfavorable weather contributed to the tightening food supply situation, it was not the principal factor. After a four-year period of record prices, the price of wheat had nearly returned to its earlier level by 1977—but only with the return to production of nearly 40 million acres of idled cropland in the United States.

There was an equally dramatic rise in the price of soybeans, a principal source of high-quality protein. (See Figure 4.) The world price of soybeans doubled between 1972 and 1973; during the five years

since then there has been no indication that the price will return to the remarkably stable pre-1972 level. The soaring price of soybeans reflects the steadily rising world consumption of protein, the deterioration of oceanic fisheries, a worldwide scarcity of land on which to produce soybeans, and the inability of agricultural scientists to raise yields significantly.

As with soybeans, the prices of the principal forest products—lumber, newsprint, and firewood—have doubled and in some cases tripled during the decade. The sharp climb in prices was commonly attributed to the global surge in economic expansion during the early seventies. Yet the subsequent slowing of economic growth in recent years has not caused prices to fall. The "ratchet effect" that seems to be operating here suggests strongly that it is not the short-term shift in demand so much as the overall relationship between the global level of demand and the sustainable yield of forests that counts.

The world price of newsprint, which was remarkably stable from 1950 until 1973, doubled within a four-year span. (See Figure 5.) In early 1978, prices moved above $300 per ton for the first time in history. Both the communication and education sectors were affected by the price rise. Many newspapers, unable to absorb the price increase, were forced to close or to merge. Others shifted to a tabloid format to reduce newsprint requirements. A great many newspapers expanded advertising space at the expense of news content.

As lumber prices climb, the cost of housing goes up everywhere. "The American dream house has passed $50,000," the *New York Times* reported on October 23, 1976. "The milestone was marked this week when the Federal Home Loan Bank Board noted that the average price of a new home bought with a conventional mortgage in the United States during September was $50,500." The announcement presented the most striking evidence yet of how the single family home—which since frontier days has been regarded as part of the American birthright—is becoming increasingly unattainable for millions of middle-income families. Within a decade the average price

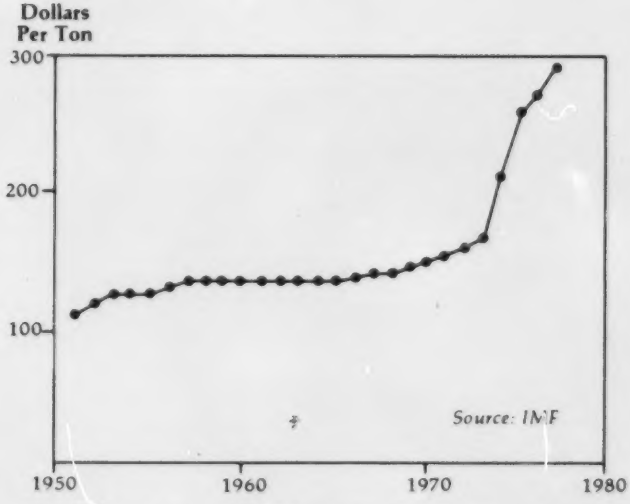

Figure 5: World Price of Newsprint, 1951-77

for a new home in the United States has climbed from just under $30,000 to just over $50,000.

Alarmed by the soaring cost of housing, U. S. Secretary of Housing and Urban Development, Patricia Harris, called for an investigation in the summer of 1977. A subsequent analysis of the long-term trends in housing costs by the Council on Wage and Price Stability focused on the costs of lumber and noted that "soaring lumber prices have been a recurring problem of increasing severity in every expansion of housing demand since the mid-sixties."[23] Until then, U.S. lumber supplies could always be easily expanded to satisfy growth in demand, but the near tripling in lumber prices since 1967 indicates that

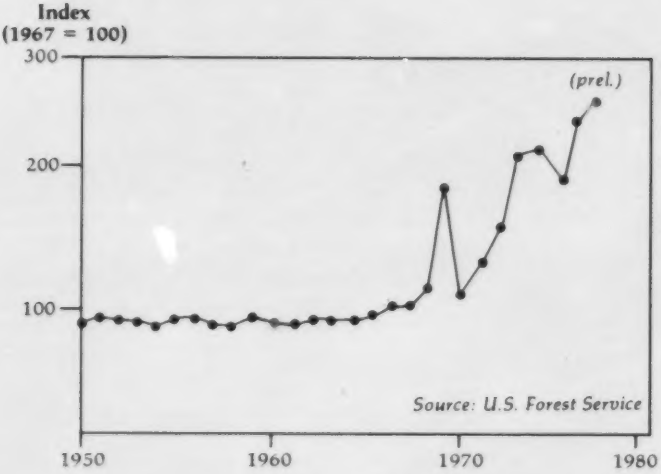

Figure 6: Wholesale Price Index for Lumber, 1950-77

this is no longer possible. (See Figure 6.) The study concluded that "over the long term the projected demand (for lumber) cannot be met by the supply of timber that will be forthcoming at current relative prices and under current management policies." Lumber prices are expected to continue their rise for at least a decade as household formation by those born during the postwar "baby boom" years presses against the yields of the nation's forests.

Although rising oil prices have commanded newspaper headlines, rising firewood prices have fueled inflation in countless Third World countries. Price rises of two-, three-, or fourfold during the seventies have not been uncommon. In Niamey, the capital of Niger, firewood purchases absorb a quarter of a manual worker's wages. In Kathmandu, Nepal, the price has tripled over the past few years; in

"The ultimate threat of uncontrolled inflation may be that people lose confidence in their governments and in social institutions."

Andean villages in Ecuador, many families are reduced to one hot meal a day. In some deforested Third World communities, what goes under the pot now costs more than what goes inside it. Soaring prices of essential consumer goods such as firewood inevitably reduce the quality of life in Third World villages.[24]

The social consequences of inflation are severe. Rapid inflation can distort both economic and social values; it can reward speculators and penalize savers. The savings of years can be wiped out almost overnight. Retired people and others on low or fixed incomes can find themselves impoverished. Inflationary stresses can also aggravate social divisions within and among societies. The ultimate threat of uncontrolled inflation may be that people can lose confidence in their governments and in social institutions, increasing the chances for violent political shifts to the radical right or left.

Inflation has long threatened global economic health, but the new sources of inflationary pressure baffle economists. The dramatic price rises for various basic raw materials do not in themselves entirely account for the overall inflationary trend of the seventies, but they are an important new factor. While "administered prices" and what amounts to administered wages are undermining the flexibility of the economic system and the ability of the marketplace to respond to inflation, rising real costs for the production of numerous key commodities and scarcity-induced price rises for others signal widespread price instability ahead. For these new sources of inflation, the traditional remedies of managing inflation by manipulating monetary and fiscal policies do not work very well.

Prime Minister Pierre Trudeau of Canada recently reflected on the difficulty of managing the inflationary pressure of recent years. "Inflation has not found its Keynes. I personally think the Keynes of inflation will not be an economist" but will instead "be a political, philosophical, or moral leader inspiring people to do without the excess consumption so prominent in the developed countries."[25] Trudeau could well be right. The remedies may not be found within eco-

nomics. They may require simpler life-styles among the affluent and new population policies that stress stability rather than growth.

Capital Scarcity

In addition to contributing to rising real costs and inflation, the diminishing returns associated with investments in many sectors of the global economy also make capital formation more difficult. Nowhere has concern about this issue been greater than at the New York Stock Exchange, the institutional heart of modern capitalism. James Needham, President of the Exchange, wrote in the preface of a report on capital scarcity that "we have become increasingly concerned about the supply and allocation of investment capital and our concerns have deepened with the realization that a capital shortage is no longer a threat for the future, but a fact of the present as inflationary pressures come to bear on the capital markets."[26]

Not all analysts agree with the conclusions of the Exchange's study. Indeed, there are few issues that more deeply divide the economics community. Some analysts see the capital scarcity issue as a ploy by the business community to obtain tax relief. These critics tend to focus on the U.S. economy rather than the global economy, where the evidence seems to be much more convincing. But perhaps the most convincing evidence of capital scarcity is the slowdown in the global rate of economic growth over the past five years, combined with the reduced expectations of future growth in the principal industrial societies.

As long as there is a need for growth, there is a need for investment capital. No economic system or enterprise can grow without it. Corporations raise capital for new investments by retaining profits, by borrowing in the financial markets (from the savings of others), or, more commonly, by doing both. Capital may be formed either through private or public means: if it is formed privately, it is derived from profits; if it is formed publicly, it is derived from taxes and

other revenues. Capital used for new investments in the automotive industry usually comes from retained profits, for example, but the capital used to build the network of highways on which cars operate comes from taxes.

All countries must be able to mobilize public or private funds or both for investment; to do so, they must make sure that production exceeds consumption. Whether a multinational corporation retains profits to finance construction of a new factory or a rural Chinese commune uses seasonally unemployed labor to expand irrigation capacity, a portion of current production is being invested to increase overall productive capacity. If the corporation has no profit margin or if all the resources of the commune are required to satisfy current consumption, then there is no capital formation.

The size of the prospective capital deficit is debatable. In a study published in the fall of 1975, *Business Week* pointed out that during the decade from 1965 to 1974, capital formation in the United States had amounted to $1.6 trillion and that an estimated $4.5 trillion would be needed during the next decade.[27] The New York Stock Exchange estimated in its study that investment requirements for 1975-84 would reach $4.7 trillion and that actual savings would amount to about $4.05 trillion, leaving a gap of $650 billion to be dealt with over the next decade.

While the best available analyses on the projected scale of the capital deficit are those for the United States, the shortage is by no means confined to North America. Like inflation, it affects the entire world. Even such efficient savers as the Japanese are running into difficulty. The centrally planned economies of Eastern Europe and the Soviet Union are collectively faced with a severe and deepening capital shortage and are scaling down their growth plans. The ailing economies of Britain and Italy also suffer from the inability to form enough capital. But while the problem may be more visible in the Western industrial countries, it is more worrisome in the poor countries, where merely meeting the needs of population increases requires

substantial capital outlays, and in the centrally planned economies of Eastern Europe.

Capital shortages in many countries have forced governments to borrow heavily abroad. In some cases this borrowing is designed to alleviate absolute shortages of capital, but in others it reflects a shortage of hard currency for essential imports of energy, food, and capital goods. Third World countries are incurring heavy debts that they may never be able to pay. Over the past decade, the Soviet Union and the countries of Eastern Europe have borrowed heavily in Western capital markets to pay for imports of food and technology, the latter largely as equipment. One source estimates Eastern bloc indebtedness at $45 billion and predicts it will continue to grow.[28]

The capital requirements in virtually every sector of the global economy are projected to increase sharply over the next decade. If U.S. energy consumption, for example, continues to expand rapidly, enormous amounts of capital will be needed. Because almost all prospective energy sources cost more than traditional ones, the energy sector has an insatiable appetite for new capital.

Agriculture too needs money to grow. The new-money needs of U.S. agriculture in 1975 were three times those of 1960, and they are growing by about 10 percent yearly.[29] Similar trends are emerging worldwide. With the settlement frontiers gone, all the currently widely used means of expanding food production, principally chemical fertilizers and irrigation, are capital-intensive. Bringing any new land into use and developing the remaining irrigation sites will invariably require heavy expenditures. So too will the expansion of fertilizer production and of distribution capacity spurred by the extension of farming onto less fertile land.

While the capital needs of U.S. agriculture are climbing, those of Soviet agriculture are soaring. Compared with the United States, the Soviet Union has a poor piece of agricultural real estate, an inefficient farm system, and a population that is growing somewhat more

"Along with the more traditional claims on new capital, additional outlays are now required for pollution control."

rapidly—a combination that has led the Soviets to commit vast amounts of capital to agriculture in an effort to upgrade diets. Increasingly forced onto land with unreliable rainfall that is subject to frequent crop failures, the Soviets are pouring vast sums of capital into irrigation projects and fertilizer production. Recent reports indicate that the Soviets are now devoting close to one-fourth of their total budget to agriculture.[30]

Satisfying future food needs in a world where the demand for grain is growing by some 30 million tons per year will require heavy annual commitments of new capital. Saburo Okita and Kimo Tahare of the Overseas Cooperative Development Fund of Japan estimate that doubling rice production in Asia over the next 15 years will require $67 billion, largely for investment in irrigation facilities.[31]

The capital requirements of the global housing industry are staggering. Faced with the need to find housing for the boom of postwar babies coming of age, the United States will require an estimated $765 billion between 1975 and 1985.[32] In poor countries with high birth rates or in those centrally planned economies of Eastern Europe that have been woefully unable to satisfy even existing housing needs, the problem takes on graver proportions. The tens of millions of people living in shantytowns on the outskirts of Mexico City, Lagos, Manila, and other Third World cities attest to a housing shortage of already staggering dimensions. Adding 64 million people each year to the earth's present population of 4 billion will not ease capital shortages in this sector.

As the scale of global economic activity continuously expands, pressures on the earth's waste-absorptive capacity mount, leading to massive expenditures on pollution abatement measures. The investment needed to control pollution and to avoid destruction of the natural systems on which the economy depends expands at a disproportionately rapid rate. Along with the more traditional claims on new capital, additional outlays are now required for pollution control, particularly in the industrial countries.

34 In the United States, pollution-control expenditures for 1972, the first year for which reasonably complete data are available, totaled $27.6 billion. (See Table 2.) By 1977, they had expanded by half to $40.6 billion. Projections of U.S. pollution-control expenditures for the decade 1975-84 show an increase in annual outlays to $73.3 billion by 1984. As a share of GNP this may come to only 2.9 percent, but as a share of capital investment it is of course much larger.

Table 2: U.S. Pollution Control Expenditures, 1972-77, and Projected to 1984

Year	Expenditures*	Expenditures As Share of GNP
	(billion dollars)	(percent)
1972	27.6	1.7
1973	30.7	1.8
1974	33.1	1.9
1975	33.6	2.0
1976	36.8	2.0
1977	40.6	2.1
1984	73.3	2.9

*Expressed in 1977 dollars.
Source: Council on Environmental Quality and U.S. Department of Commerce.

A Battelle Institute compilation of actual and planned pollution-control expenditures for West Germany found that this heavily industrialized country will spend about $16 billion on pollution-control plants and equipment between 1975 and 1979.[33] In Japan, where worsening pollution is visibly affecting human health, similar claims are diverting capital from further industrial expansion. Indeed, this necessary diversion has contributed to the halving of Japan's rate of economic growth since the early seventies.

Worldwide, investments in pollution control are particularly heavy in the paper, chemicals, and petroleum industries. Pollution-control expenditures for the U.S. paper industry grew from $93 million in 1968 to $644 million in 1975, a sevenfold expansion. These expenditures accounted for nearly one-third of all capital investment in the pulp, paper, and paperboard industries in the mid-seventies. According to one report, "rising capital outlays just for pollution-control expenditures resulted in a marked shrinkage in funds for maintaining facilities and increased expansion in the paper industry."[34]

Industrial waste is not the only environmental pollutant with far-reaching economic consequences. The noise associated with the use of modern technologies has climbed to a level where it is now posing serious physical and psychological problems, including irreversible hearing impairment. Recent U.S. Government regulations designed to reduce noise to a more tolerable level will require airlines, for example, to invest some $5-$8 billion dollars over the next five years.[35] Given a population of 210 million, this proposed effort to reduce aircraft noise will cost each American an average of $30.

While numerous studies indicate that severe capital shortages are in store, the issue is by no means settled. Some economists point out that interest rates are not rising when adjusted for inflation. This may be, but other economists predict that interest rates will rise still further. It is also worth noting that economic growth rates are slowing, perhaps indicating the reluctance of investors to borrow at potentially higher interest rates. Some economists argue that capital deficits never occur in the real world and that the supply of money always balances with the demand at the appropriate market price (which in the case of capital is the interest rate). While few economists would challenge this point, the fact remains that some social goals will not be met if interest rates are excessively high.

Unemployment: A Growing Social Ill

Both the total number of workers without jobs and the share of the global work force that is unemployed have climbed steadily during

the seventies. Two factors are responsible: the slowing rate of economic growth and the record expansion in the global labor force. In isolation, either could have led to rising unemployment. Coming together, they have aggravated each other, leading to unprecedented unemployment levels in much of the world.

Historically, policymakers have relied on economic growth to create additional employment. During the sixties, the record growth rates in northwestern Europe led to job creation that exceeded the increase in the labor force. In fact, acute labor shortages plagued northwestern Europe and Japan during the sixties and early seventies as the jobs available outnumbered the new entrants to the job market.

As economic growth rates accelerated in Western Europe, several governments—including Belgium, France, Germany, the Netherlands, and Switzerland—began to offer jobs for an unspecified period of time to workers from Mediterranean countries. Not surprisingly, many "guest" workers arrived from countries where wages were low and jobs were scarce. By the early seventies, the migrants in Western Europe from countries such as Algeria, Greece, Morocco, Portugal, Southern Italy, Spain, Tunisia, Turkey, and Yugoslavia numbered an estimated 10 to 11 million, a number matching the combined populations of Denmark and Ireland. In some countries, anywhere from 5 to 35 percent of the labor force consisted of these guest workers.[36]

Since then, dramatic changes have occurred. Many of the industrial countries have been unable to find jobs for their own citizens in the wake of the slowing economic growth of the mid-seventies. Millions of guest workers have left for home. Their departure has helped the unemployment problem in northwestern Europe, but it has worsened that of the former guest workers and of their home countries.

One of the most visible signs of rising unemployment in the developing countries has been the outmigration of job seekers. In 1977, an estimated 8 to 12 million illegal immigrants made their homes in the United States. Surveys indicate that probably half or more were Mex-

ican. What began as a trickle of illegal aliens crossing the U.S. border has now become a flood. While the Immigration and Naturalization Service (INS) has 8,000 employees and an annual budget of $160 million with which to enforce the immigration laws, it is not equipped to even begin to cope with the problem.[37] The INS is so overwhelmed that it will respond only to tips on groups of illegal aliens working in the United States; it makes little attempt to prosecute or deport isolated individuals. Moreover, the agency is short of funds needed to ship apprehended aliens home.

Indeed, some six million aliens were thought to be actually holding jobs in the United States in 1977, equaling the number of Americans out of work and actively seeking jobs.[38] Illegal immigrants make a mockery of immigration laws and of the workers who wait patiently for years to migrate to the United States legally. They often collect welfare payments as well, adding to the problems of cities like New York that are fighting to keep afloat financially. Unemployment spreads as the chances for continuing rapid economic growth disappear. The number of unemployed in North America, Japan, and the industrial countries of Western Europe—some 17 million workers—reached a 40-year high during the recession of the mid-seventies.[39] This continuously expanding corps of jobless is becoming a serious burden. Not only are they draining unemployment and welfare funds but they are also unable to contribute to the national product.

In many poor countries, entrants into the job market outnumber new jobs by two to one. The work force in India was projected to increase from 210 million to 273 million during the seventies. There are 100,000 new entrants to the Indian labor force each week. At least 15 percent of the labor force is already unemployed; another sizable percentage is underemployed. Data for scores of other countries now show the same trend.[40]

The International Labour Office (ILO) estimates that close to 40 percent of the labor force in the less developed countries (excluding China) was either out of work or underemployed in 1975. They pro-

ject the work force in the developing world will expand by 86 percent between 1970 and the end of the century, requiring a phenomenal 880 million additional jobs. (See Table 3.) In developed countries, meanwhile, the ILO expects a 29-percent increase in additional jobs required.

Table 3: Projected Growth in World Labor Force, 1970-2000

	1970	2000	Additional Jobs Required	Change, 1970-2000
		(millions)		(percent)
More Developed Nations	486	627	141	+29
Less Developed Nations	1,021	1,901	880	+86

Source: International Labour Office.

The retirement of older workers makes room for young people entering the job market in industrial countries. In developing countries with high birth rates, on the other hand, comparatively few older workers retire each year. Consequently, up to two-thirds or more of all new entrants to the labor market in these nations require newly created jobs.

According to the ILO projections, the world labor force will increase by an average of 30 million per year during the closing decades of this century. Employing that number of people each year in productive ways will require vast amounts of capital and natural resources, including energy. The creation of new employment requires something for people to work with, some form of capital. For the half or so of the global labor force in agriculture, that "something" is land. From 1500 onward, the jobless moved to the frontiers of human settlement where land could be obtained for the asking. This movement

"Social analysts seldom take into account the ecological deterioration now threatening the livelihood of those who directly depend on the offtake of the four biological systems."

long saved Europe from overpopulation. As long as these frontiers existed, people who wanted to work the land needed only a small amount of money—enough to buy crude farm implements and seed. But now that land for settlement has become scarce or concentrated in a few hands, this method of job creation is impossible without land redistribution.

Social analysts customarily try to weigh the impact of political and technological forces on the distribution of income and wealth, but they seldom take into account the ecological deterioration now threatening the livelihood of those who directly depend on the offtake of the four biological systems. Several categories of people come to mind—shifting cultivators, nomadic herdsmen, fishermen, and mountain dwellers. Most, but not all, of these vulnerable people live in developing countries.

The deterioration of fisheries from overfishing or from offshore pollution, for example, has brought fishermen and those who depend indirectly on the catch to the shores of economic ruin. Fishing communities in Japan, in the United Kingdom, in the State of Massachusetts, and in the coastal regions of Peru have seen their "net income" plummet during the seventies as their fisheries have been decimated. The collapse of Peru's anchovy fishery, once the world's largest, has left tens of thousands of Peruvians without productive employment.

In the spring of 1977, heavy offshore pollution led to the closing of 1,000 hectares (30 percent) of the productive clam beds off Long Island. In one community alone, an estimated 1,000 clammers were put out of work and a million-dollar-a-year clam industry collapsed.[41] In the global scheme of things, these local losses may seem small. But multiplied hundreds of times over, they make a measurable difference in human welfare.

As population pressure builds, fallow cycles are shortening, leading to a deterioration of land fertility. Other ecological forces, especially

grassland deterioration and desert encroachment, affect nomadic herdsmen. Associated with population pressures, these forces are wreaking their greatest havoc in Africa on the broad fringe of the Sahara and on the East African plateau, in the Middle East, and in parts of northwestern Asia such as Iran and Afghanistan. As a UN report covering income distribution in the Middle East notes, "The continued deterioration in the rural environment and the natural rangeland zone were among the main causes responsible for the impoverishment of the nomads, pastoralists, and farmers in the arid and marginal areas."[42]

Another class of ecological refugees includes the mountain folk of overpopulated poor countries. As population pressure has forced farmers up the hillsides in the Western Himalayas, in the Ethiopian highlands, and throughout the Andes, soil erosion has grown severe. As the soil washes down from the mountains, the people are never far behind. Most of these former farmers and their families wander into the tin-and-filth squatter settlements that circle Third World cities, and few ever find productive employment. In effect, these farmers have been disenfranchised; they have lost their natural capital.

Few wage-earners are completely exempt from the effects of population pressures or pollution (or of some combination of the two) on natural systems. As these pressures intensify, many groups will be robbed outright of their income and security. Many more will be hurt indirectly. Of all the sources of rising unemployment, ecological deterioration may be one of the most difficult to remedy.

The Changing Growth Prospect

The factors outlined above—including diminishing returns on investments in basic sectors of the global economy, unprecedented inflationary pressures, and widespread capital scarcity—are all slowing

"The global engine of economic growth is clearly losing steam."

economic growth during the seventies. The global engine of economic growth is clearly losing steam. This slowdown did not originate in some sudden human failure to manage the economic system. Rather it is rooted in humanity's relationship to the carrying capacity of biological systems, the dwindling reserves of oil, the declining quality of mineral ores, and the ecosystem's limited capacity to absorb waste. In effect, the changing growth prospect reflects the constraining forces inherent in the earth's natural systems and resources.

From 1966 through 1973, the global economy expanded at almost exactly 5 percent per year, a rate characteristic of the postwar period. (See Figure 7.) Then, almost overnight, the rate of expansion began to fall. A steep descent from the 1973 peak brought growth down to less than 2 percent in 1974, and to less than 1 percent in 1975. The global economy resumed a respectable 5-percent growth rate in 1976 but then promptly subsided to 3.8 percent in 1977. Preliminary estimates for 1978 indicate a further fall in the growth rate, with the possibility of a world recession in 1979.[43] The average annual growth rate of some 3 percent for the past five years certainly does not in itself constitute a new trend. Yet combined with this analysis and with the slower national growth projected by several key industrial countries, it suggests a measurable slowing in future global economic growth from postwar levels.

The slowdown in growth coincides with the quadrupling of world oil prices at the end of 1973, and while this was a dominant contributing factor, it was by no means the only one. Protein prices were also moving up to new levels as growth in the fishery sector of the world economy came to a halt. The oil export embargo of late 1973 followed the U.S. soybean export embargo and the massive 1972 Soviet wheat purchases that decimated the world's food reserves. The energy and food sectors, both characterized by remarkably stable, low prices throughout the postwar period, were undergoing a fundamental transformation. The rise in prices of energy and of protein will not be easily reversed.

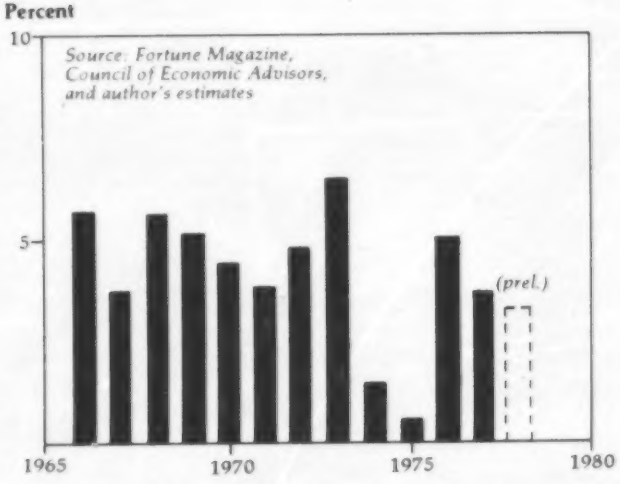

Figure 7: World Economic Growth Rate, 1966-78

In addition to these stresses, in the more affluent societies such as Sweden and the United States consumer desires are showing early signs of satiation. Young people in the upper-income groups in the United States place less emphasis today on the acquisition of material goods than did their parents. In Sweden, Goran Backstrand and Lars Ingelstam ask what Swedes could possibly do with the sevenfold increase in steel output and the tenfold increase in chemicals that a projection of the traditional 4- to 6-percent annual growth rates would yield. Further, they question whether Swedes would tolerate the environmental disruption such growth would imply when their essential material needs are already more than satisfied.[44]

Economic expansion has slowed measurably during the seventies in France, Germany, Japan, the United Kingdom, the United States, the Soviet Union, and most other industrial countries. The heady 10- to 14-percent annual growth that characterized the Japanese economy during the sixties and early seventies now appears to be history. More recent growth rates and considerations of growth targets focus on a range of 4 to 7 percent. Faced with deeply feared inflationary pressures, the government of West Germany is now prepared to settle for a 3.5-percent annual growth, regardless of the international pressures for more rapid expansion. The economic predicaments besetting the Soviet Union and Eastern Europe are reflected in their most recent development plans, which set out substantially lower growth targets as well as reduced capital investment.[45]

Although the economic thinking and goal setting of individual countries is being at least subtly altered by the changing economic prospect, an international dialogue on its dimensions and the contributing factors has been curiously lacking. Reactions to the changing economic prospect suggest both a tendency to view it as temporary and a feeling that it is somehow a response to peculiar local conditions rather than a worldwide phenomenon. The few efforts to think in global economic terms, such as the UN-sponsored *The Future of the World Economy*, seem largely to ignore the fundamental changes in the global economic prospect.[46]

Even at the national level, little effort has been made to analyze the changing growth prospect. One exception is the 12-volume study by the Joint Economic Committee of the U.S. Congress released in early 1978 that exhaustively considers the future growth of the American economy. The authors conclude that growth of the economy "will slow from its level of 4 percent per year for the past 15 years to the range of 3 percent by the late eighties and perhaps less in the nineties."[47] The slowdown is attributed to rising real costs of materials, a drop in the new entrants to the labor force, and possible shifts in personal values away from materialism. Although the Joint Economic Committee study attempted to be comprehensive, it largely overlooked

the effect on growth of the deterioration of the earth's biological systems. Had this been incorporated, the projected slowdown might have been even greater.

The slowdown in economic growth in the United States is being paralleled or even preceded by a deceleration of Soviet growth. In his analysis of the Soviet economy, Abram Bergson reports that in terms of that familiar barometer, real national income, "the Soviet economy has indeed been slowing down, and markedly so."[48] In its plan for the 1975-80 period, the Soviet Planning Agency, Gosplan, adopted the lowest growth target ever. A fall in the tempo of capital accumulation has contributed to the fall in the growth rate. The labor force is also expanding more slowly.

Brazil, after years of a heady 9-percent annual growth, is scaling down its goals as its economy struggles with the high cost of energy and with a swollen external debt.[49] While rapid growth economies such as Brazil are scaling down their plans and expectations, less robust national economies find themselves in exceedingly difficult straits. Cornucopian promises for the future are no longer made in Cuba, where the government now projects a slower growth rate than in the recent past.[50] The prospect of static living standards, or even of lower standards in some countries, is not just a remote possibility.

As the prospect of diminishing growth gives way to the reality, the distribution of wealth will become an even more pressing issue. As long as growth continued at a robust pace, the rich within a society could always say to the poor, "Be patient, the pie is expanding; wait your turn, your time is coming." At the international level, the "haves" could always give the "have-nots" the same assurance. But when the pie is no longer expanding, or expanding only slowly, the question becomes how to divide it—a vexing issue both within and among societies.

Even when economies were still expanding rapidly during the late sixties and early seventies the "trickle down" theory of economic

"As the prospect of diminishing growth gives way to the reality, the distribution of wealth will become an even more pressing issue."

growth was becoming unacceptable. In some countries, planners are shifting to a "basic human needs" development strategy. At the international level, the "have-not" countries are pressing for a New International Economic Order. Bolstered in recent years by the political muscle of OPEC, their calls cannot be easily disregarded.

The Implications for Economic Policy

The changing relationship between the expanding global economy and the earth's natural systems and resources is bringing into question the appropriateness of many existing economic policies and goals. As human needs outstrip the carrying capacity of biological systems and as oil reserves shrink, the emphasis in economic policy will of necessity shift from growth to sustainability. This is not to suggest that growth as a goal should be abandoned, but that the blind pursuit of material growth for its own sake, with a continuing lack of concern for the carrying capacity of biological systems, could lead to the destruction of the very systems that supply the food and raw materials on which the economy depends.

Formulating an economic policy for a sustainable society will be a complex process. Many of the old assumptions and guidelines will have to be discarded. A sustainable economic system will reflect explicit recognition of the need to stabilize the relationship between humanity and the earth's principal biological systems—fisheries, forests, grasslands, and croplands. In effect, this means devising comprehensive economic policies and plans that limit the offtakes or harvests from these systems to sustainable levels. The question is not whether the harvests will be limited. They will be limited—either through the exercise of foresight and careful management or through the eventual destruction of the systems.

A sustainable economic system is possible only if alternative energy sources are developed before world oil production turns downward and before world economic disruptions occur. Thus the adjustments

in the economy dictated by the carrying capacity of biological systems will be paralleled by the adjustments, equally profound, associated with the shift from oil to other fuel sources. These changing circumstances suggest that economic policymakers and planners must pay more attention to how to restrict the growth in demand for scarce resources. Indeed, without such a shift in focus it may not be possible to cope satisfactorily with rising real costs and scarcity-induced price rises.

These two general sources of change suggest four specific adjustments in economic policy. The first three all deal with the need to restrict the growth in resource use—putting the brakes on population growth long before it reaches the UN-projected 10 to 16 billion, limiting the consumption of scarce resources, and redesigning the economic system so that all raw materials are recycled. The fourth adjustment is the fundamental alteration of the economic relationship between the industrial and developing economies.

Effective economic planning and policymaking will require national population policies that encourage family sizes and population growth rates consistent with resource availability. For the vast majority of countries, present resource constraints are such that a vigorous program to stabilize population will be essential if even the most basic human needs are to be met.

Unfortunately, the economic and social policies of most countries are still overwhelmingly pro-natalist. A number of European nations still grant baby bonuses, a holdover from an earlier era of higher infant mortality and of the belief that there was strength in numbers. Other countries allow income tax deductions for unlimited numbers of children. Only a few countries, such as China and Singapore, have adopted comprehensive population-stabilization policies.

As global economic growth slows, the wide variations in national population growth rates will become far more important and conspicuous. Countries with stable or slowly-growing populations can

"A 2-percent rate of economic growth would lead to steady per capita income advances in East Germany and Belgium, but to a steady deterioration in Peru or Senegal."

weather a slowdown in global economic growth, while those with rapidly growing populations are highly vulnerable. Any rate of economic growth, however modest, leads to per capita income rises in areas where population growth has stabilized. A 2-percent rate of economic growth would lead to steady per capita income advances in East Germany and Belgium, but to a steady deterioration in Peru or Senegal.

Even as population growth begins to stabilize in various countries, there will be a need to limit individual claims on scarce resources. Consumption of scarce resources may be restricted through formal rationing programs, through the operation of market forces in the form of higher prices, or through voluntary limitations. Most countries will rely on some combination of these three approaches.

Individual countries are already beginning to limit the offtake of biological systems in a variety of ways. Finland has established a national quota on the offtake from its shrinking forests. Sweden may shortly follow the Finnish example. International market forces will allocate the reduced supplies among the various countries that import forest products from these countries. Meanwhile, the United States, along with many other countries, has extended the offshore fishing limit to 200 miles in order to preserve the nearby oceanic fisheries. The U.S. Government establishes an upper limit for the catch in each fishery, and then allocates the catch among interested countries according to a formula based on historical shares and on other relevant considerations. Although these governmental actions may raise prices of forest products and seafood in the short run, they may be the only means of assuring supplies over the long run.

Some governments are using price mechanisms to restrict consumption. This may be done either directly through market intervention or indirectly through tax policies. Several European countries, including France, Italy, and West Germany, impose a heavy tax on gasoline, one that exceeds the cost of the gasoline itself. In these nations, gasoline prices now range from $1.20 to $2.05 per gallon.

48 Even socialist countries are using the price mechanism to restrict demand. In early 1978, the Soviet Union announced the government-set price for gasoline was being doubled from 62¢ per gallon to $1.20.[51]

In the United States, gasoline use is being curbed indirectly by legislation that has established progressively higher levels of fuel efficiency for automobiles sold over the next several years. The reduced speed limit of 55 miles per hour, though commonly violated, has led to lower average speeds and corresponding savings in fuel. Requests to individuals and businesses to lower thermostats in winter, hoping for voluntary changes in behavior, have also helped curb fuel use. Unfortunately, these actions to conserve energy have not succeeded in reducing the growing oil import bill.

Social policy has traditionally been used to establish minimum consumption levels through such means as progressive income taxes and various welfare programs. Some countries are now moving into a situation where they must use social policy extensively to establish maximum levels of consumption for scarce resources as well. The government of China, which has long experienced intense population pressure on available resources, rations many essentials, including rice, clothing, kerosene, and other basic consumer goods.[52]

As resources become more scarce and costly, governments will find it necessary to distinguish between the amount of raw material used per capita and the amount of goods and services produced per capita. These two amounts can vary widely among societies with comparable consumption levels. Swedes and Germans enjoy a level of living comparable to that of Americans but consume scarcely half as much energy per capita.

An economic system that efficiently recycles materials not only saves raw materials but also uses far less energy. Recycled aluminum requires only 5 percent as much energy as that processed from bauxite.[53] A society that permits only the use of returnable bottles uses far less

energy than one that relies on throwaways. Similarly, a society that recycles waste paper effectively can provide the same level of paper use as one that does not, using far fewer trees. The distinction between the quantity of raw materials used and the benefits provided is an important one that should increasingly influence economic policy-making. In effect, a society that extensively recycles raw materials can achieve a high level of living with a relatively low level of use of raw materials and energy.

The change in the economic relationships between industrial and developing countries suggested by the changing economic prospect is potentially a profound one. Presently the developing countries are closely tied to the industrial economies of Europe, Japan, and North America. Whenever the growth of these industrial economies slows, a slowdown in growth in the Third World follows. Conversely, when growth in the industrial economies accelerates, so does that in Third World economies. With a period of prolonged slow growth apparently in prospect for the industrial societies, a continuation of this dependence by the developing countries will therefore inevitably lead to a slowing of their economic growth, perhaps below that of their population.

Faced with this clearly untenable situation, the developing countries would seem to have little choice but to gradually decouple their economies from those of the industrial societies and concentrate instead on expanding their trade and investment ties with each other. The bases for expanding economic ties among Third World countries are far greater than they were even a decade ago, in part because most of the world's oil exports come from Third World countries. In addition, some Third World countries have developed an impressive industrial capacity—South Korea, Taiwan, India, the Ivory Coast, Venezuela, and Brazil. The import markets of OPEC countries are growing rapidly as a result of the steep rise in energy prices. Opportunities for expanded trade and investment ties, not to mention labor migration, between such countries as Pakistan and Saudi Arabia or India and Iran are substantial and growing. Nigeria's energy supply combined with

50 Brazil s advancing industrial capacity presents interesting possibilities for new linkages between these two countries, the most populous on their respective continents. In effect, this conscious strengthening of economic ties among Third World countries and accompanying diminution of ties with industrial economies might deserve to be the organizing theme of the New International Economic Order.

As the role of oil declines in the years ahead and renewable energy sources come to play a more prominent role, the growth in economic interdependence among all countries that has characterized the past generation seems certain to slow, and it could even decline in absolute terms. Turning to renewable energy sources, which are almost by definition local in nature, will lead increasingly toward national energy self-reliance and in turn greater economic self-reliance. In a world economy in which energy is no longer cheap and abundant, the cost of transporting goods long distances will become more formidable. The net effect will be to reduce international trade, particularly in bulk commodities, below what it would otherwise have been.

The changing economic prospect will undoubtedly call many existing social goals into question. More specifically, future developments will bring into focus a growing divergence between traditional economic goals and evolving social goals. As the rate of economic growth slows, societies will need to distinguish more clearly between the volume of consumption and the quality of life. There will be a need to redefine national goals in terms of basic human needs.

Historically, economic policymakers have relied on economic growth to create jobs. But the emerging constraints on growth may require a new approach. In abandoning the conventional job-creation approach of calling for the consumption of more energy, future economic planners may try to simultaneously conserve energy and create employment. For instance, banning the use of throwaway bottles and requiring all containers to be returnable not only saves energy, but also increases employment, reduces litter,

and cuts overall costs. The same is generally true for the recycling of all materials, including newsprint, aluminum, steel, and copper. The development of renewable energy sources, ranging from reforestation programs to the installation of rooftop solar collectors, is far more labor-intensive than some of the alternatives such as nuclear power plants. Employing the vast numbers of new entrants to the job market expected each year between now and the end of the century will be difficult. But it is by no means impossible, given enlightened leadership.

In the future, a healthy economy designed to satisfy basic needs with a minimum of resource depletion may accord conservation a higher place than consumption. Such an economy could be more self-sufficient, and therefore less vulnerable. Its hallmark would not be the rate of economic expansion but the efficiency of resource use.

As growth becomes both more difficult to achieve, and in some situations less relevant to the attainment of basic human needs, it is inevitable that issues of sustainability and the distribution of wealth will take on renewed importance. Continuing short-term preoccupation with growth at the expense of sustainability would lead to marked instability in the economic system. Similarly, a failure to address the issue of the distribution of wealth in a situation of slowing growth would almost certainly lead to social tensions if not an undermining of political institutions.

Aside from the scale of the changes in prospect, the dominant characteristic of the global accommodation is its urgency. Many of the adjustments needed to preserve the basic biological systems on which the economic system depends have been put off for too long. Already, overharvesting is leading to shrinkage of the productive resource base. With energy, too, valuable time has been lost pursuing the nuclear dream. With the prospective downturn in oil production now only a decade or so away, the world is still without any coherent idea of what will fuel the economy when the oil wells begin to go dry.

52 The changes involved in accommodating ourselves to the earth's natural capacities and resources suggest that a far-reaching economic transformation is in the offing. The origins of the change are ecological, but the change itself will be social and economic. And the processes for achieving it will be political.

The economic adjustments facing national governments are not easy ones. They require economic advisors and political leaders to absorb a vast amount of new information, often on unfamiliar subjects, and to devise new analytical tools and new modes of thinking. In most countries, they will lead to economic systems markedly different from those we now know.

Unless economists can gain a better understanding of our economic dependence on the earth's natural systems, they will be hard pressed to advise political leaders wisely. We may thus end up treating the symptoms of our economic maladies rather than the causes. In economics, as in medicine, this can be dangerous.

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